

# Best Available Science

---

*A Review of Literature  
and  
Assessment of the Proposed  
Critical Areas, Clearing and Grading,  
and Stormwater Ordinances*

---

PUBLIC REVIEW DRAFT  
OCTOBER 2003



King County

Department of Natural Resources and Parks  
**Water and Land Resources Division**  
201 South Jackson Street, Suite 600  
Seattle, WA 98104  
206-296-6519 TTY Relay: 711  
[dnr.metrokc.gov/wlr](http://dnr.metrokc.gov/wlr)

**Department of Development and Environmental Services**  
**Department of Transportation**

Text Location: \\wlrnt2\\wordproc\\F\\BEST\_AVAILABLE\_SCIENCE  
\\BAS\_FINAL CHAPTERS\\  
Graphics: WLRNT8\\WORKGROUPS\\Science\\0310 BAS report\\

Printed on recycled paper

Alternate Formats Available  
206-296-6519 TTY Relay: 711

# **Chapter 1: INTRODUCTION**

1	INTRODUCTION .....	1
1.1	Background.....	1
1.2	Purpose.....	2
Risk Assessment.....		2
2	CONTEXT.....	3
2.1	Overview of Laws, Policies, and Programs for Resource Conservation .....	3
2.2	Land Use Overview .....	5
3	OVERVIEW OF ORDINANCES .....	6
3.1	Overview of the Proposed Critical Areas Ordinance.....	8
Options For CAO Compliance.....		8
3.2	Overview of Proposed Stormwater Ordinance and Surface Water Design Manual Update.....	10
Proposed Requirements.....		11
3.3	Overview of Proposed Clearing and Grading Ordinance .....	12
4	REVIEW OF CONTENTS.....	13
5	REFERENCES .....	14

# **Chapter 2: SCIENTIFIC FRAMEWORK**

1	Scientific Framework.....	1
2	Landscape Effects.....	3
3	Conclusion .....	5
4	References .....	5

# **Chapter 3: FLOOD HAZARD AREAS**

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE.....	1
2.1	Description of Flood Hazard Areas .....	1
2.2	FEMA and the NFIP .....	2
2.3	Flood Hazard Area Functions .....	3
	Natural Floodplains .....	3
	Floodplain Alterations and Impacts .....	4
2.4	Flood Hazard Area Protection .....	4
	Flood Hazard Mapping and Regulation .....	4
	Contemporary Floodplain Management Policy and Regulations.....	7
	Impacts of Traditional Flood Control Facilities .....	8
	Contemporary Design and Construction Guidelines for Flood Protection Projects.....	8
	Comprehensive Floodplain Management Plans .....	9
2.5	Gaps in the Knowledge and Areas of Uncertainty.....	10
3	ASSESSMENT OF THE PROPOSED KING COUNTY STANDARDS .....	11
3.1	Flood Hazard Area Classification .....	11
	Flood Hazard Area Classification .....	11
3.2	Fixed Regulations – Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	12
	Restrictions on Development to Protect Public Safety.....	12
	Farm Planning .....	16
3.3	King County Flood Hazard Reduction Projects and Programs.....	17
4	CONCLUSION.....	17
5	LITERATURE REFERENCES.....	18

# **Chapter 4: CHANNEL MIGRATION ZONES**

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE .....	2
2.1	Channel Migration Physical Processes .....	2
	Channel Migration Overview.....	2
	Types of Channel Movement .....	4
	Natural Factors that Constrain or Influence Channel Migration .....	5
	Connectivity Between Channel Migration, Floodplains, and Habitat.....	6
2.2	Mapping Channel Change.....	7
2.3	Studies that Evaluate CMZ Definitions and Delineation.....	7
2.4	Existing Regulatory Definitions of Channel Migration Zone (CMZ) .....	9
3	ASSESSMENT OF PROPOSED KING COUNTY STANDARDS .....	11
3.1	Introduction.....	11
	Hazard to Humans .....	11
3.2	Channel Migration Zone Classification and Definition .....	12
3.3	Fixed Regulations – Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	15
	Restrictions on Development to Protect Public Safety.....	15
	Allowed Alterations .....	16
3.4	Other King County Management Actions that Contribute to CMZ Protection .....	19
4	SUMMARY AND CONCLUSIONS .....	19
5	REFERENCES .....	20

# **Chapter 5: GEOLOGIC HAZARD AREAS**

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE .....	1
2.1	Seismic Hazard Areas .....	1
	Seismic Hazard Area Functions .....	2
	Subsidence and Uplift .....	4
	Ground Failure .....	4
	Landslides.....	5
	Liquefaction .....	6
	Differential Compaction.....	7
	Water Waves .....	7
	Seismic Hazard Area Protection.....	8
2.2	Erosion Hazard Areas .....	8
	Erosion Hazard Area Functions .....	10
	Erosion Hazard Area Protection.....	10
2.3	LANDSLIDE HAZARD AREAS .....	11
	Landslide Hazard Area Functions .....	12
2.4	VOLCANIC HAZARD AREAS .....	14
	Volcanic Hazard Area Functions .....	15
2.5	COAL MINE HAZARD AREAS.....	19
	Coal Mine Hazard Area Functions.....	19
	Coal Mine Hazard Area Protection .....	22
3	ASSESSMENT OF PROPOSED KING COUNTY STANDARDS .....	22
3.1	Fixed Regulations - Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	22
	Restrictions on Development to Protect Public Safety.....	22
	Allowed Alterations .....	24
4	CONCLUSION.....	25
5	LITERATURE REFERENCES.....	26

# **Chapter 6: CRITICAL AQUIFER RECHARGE AREAS**

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE .....	1
2.1	Definition of Aquifer Recharge Areas .....	1
2.2	Prioritizing Aquifer Recharge Areas (Which are Most Critical?) .....	3
2.3	Identification and Assessment of Threatening Land-Use Activities.....	6
	Water Quality .....	6
	Water Quantity .....	19
	Monitoring.....	20
	Protection Efforts .....	22
2.4	Special Areas / Issues of Concern Specific to King County .....	24
3	ASSESSMENT OF PROPOSED KING COUNTY STANDARDS .....	26
3.1	Critical Aquifer Recharge Area Classification .....	26
3.2	Fixed Regulations - Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	27
	Restrictions on Development to Protect Public Safety.....	27
	Stormwater Control .....	29
4	CONCLUSIONS .....	30
5	LITERATURE REFERENCES.....	30

# Chapter 7: AQUATIC AREAS

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE.....	2
2.1	Processes that Form and Sustain Aquatic Areas and Species .....	2
The Role of Water .....	2	
The Role of Glaciers .....	3	
The Role of Forests .....	3	
The Role of Animals .....	4	
2.2	Natural Cycles of Change and the Role of Disturbance .....	5
Channel Migration and Shoreline Erosion .....	5	
2.3	The Diversity of King County's Aquatic Life .....	6
Salmonids as Indicator and Keystone Species .....	6	
Other Species as Indicators .....	8	
2.4	Integrated Ecological Models: The River Continuum Concept and Marine Intertidal Zonation .....	8
2.5	Effects of Land Development on Aquatic Habitats and Species .....	12
2.6	Processes Conclusion.....	13
2.7	Strategies for Protection.....	14
2.8	Approaches to Aquatic Area Protection .....	15
Riparian Areas.....	16	
Protecting Landscape Scale Functions .....	25	
2.9	Strategies for Protection Conclusion .....	26
3	ASSESSMENT OF PROPOSED KING COUNTY STANDARDS.....	27
3.1	Fixed Regulations – Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	27
Buffers .....	27	
Allowed Alterations .....	31	
Mitigation .....	32	
Clearing Restrictions .....	32	
Stormwater Control .....	34	
3.2	Farm Planning.....	36
3.3	Rural Stewardship Planning .....	36
3.4	Institutional Context and Consistency with BAS .....	38
Institutional Risks and Uncertainties.....	40	
4	CONCLUSION.....	40
5	LITERATURE REFERENCES.....	41

# Chapter 8: WILDLIFE AREAS

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE .....	1
2.1	Conservation Theory.....	2
	Landscapes, Ecosystems, and Populations.....	2
	Ecosystem-Based Adaptive Management.....	2
	Contemporary Ecology and the Implications for Conservation.....	3
2.2	Wildlife Areas Functions .....	5
	Human Dominated Landscapes and Variation of Functions Over Time.....	5
	Wildlife Areas Protection.....	7
	Existing Habitat and Wildlife Protection .....	7
	Protection Suggested by Literature .....	8
2.3	Protecting Individual Wildlife Species .....	14
	Spotted Owl.....	15
	Peregrine Falcon.....	16
	Vaux's Swift.....	17
	Marbled Murrelet .....	18
	Townsend's Big-Eared Bat .....	19
	Osprey .....	21
	Northern Goshawk .....	23
	Great Blue Herons.....	25
	Bald Eagles.....	27
	Remaining "Shall" Species .....	28
	"Should" Species.....	28
2.4	Priority Habitats .....	36
	Caves .....	36
	Cliffs.....	38
	Talus .....	39
	Snags .....	40
	Old-Growth and Mature Forest .....	42
	Wildlife Corridors .....	43
3	ASSESSMENT OF PROPOSED KING COUNTY STANDARDS .....	45
3.1	Fixed Regulations – Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	46
	Nine "Shall" Species .....	47
	Remaining "Shall" Species .....	59
	Wildlife Habitat Network.....	60
	"Should" Species.....	62
	Habitat Protected through Financial Incentives .....	62
	Allowed Alterations .....	62
	Mitigation .....	63
	Clearing Restrictions .....	63
	Buffers .....	65
3.2	Rural Stewardship Planning.....	65
3.3	Farm Planning.....	67
4	CONCLUSIONS .....	68
5	LITERATURE REFERENCES.....	70

# **Chapter 9: WETLANDS**

1	INTRODUCTION .....	1
2	REVIEW OF LITERATURE .....	1
2.1	Wetland Definitions and Types .....	1
2.2	Wetland Functions .....	3
	Determinants of Function.....	3
	Interaction of Wetland Functions .....	4
	Variation of Functions Over Time .....	4
	Protection of Wetland Functions.....	5
2.3	Existing Protection Methods.....	5
	Buffers.....	5
	Stormwater Management .....	9
	Wetland Mitigation .....	10
	Watershed and Landscape Protection.....	13
	Ecosystem Level Management Based on Functional Criteria.....	14
	Adaptive Management .....	15
	Wetland Functions and Their Protection at Four Spatial Scales .....	15
3	ASSESSMENT OF PROPOSED CAO STANDARDS .....	42
3.1	Fixed Regulations – Proposed Critical Areas, Clearing and Grading, and Stormwater Ordinances.....	42
	Wetland Classification .....	42
	Buffers.....	47
	Mitigation .....	50
	Allowed Alteration.....	52
	Stormwater Control.....	53
	Clearing Restrictions .....	55
3.2	Farm Planning.....	57
	Rural Stewardship Planning .....	58
4	CONCLUSION.....	62
	Closing Points .....	65
5	LITERATURE REFERENCES.....	65